

New and poorly known species of the *mexicanus* group of the genus *Vaejovis* (Scorpiones: Vaejovidae) from Oaxaca, Mexico

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Abstract. Four new species belonging to the *mexicanus* group of the genus *Vaejovis* C.L. Koch 1836 from Oaxaca, Mexico are described. The number of species of this group for the state is raised to seven. The males of *V. franckei* and *V. setosus* are described for the first time. A key to Oaxacan species of the *mexicanus* group is provided.

Keywords: Scorpion, taxonomy, biodiversity, new species

The *mexicanus* group of the genus *Vaejovis* C.L. Koch 1836 has been one of the most neglected groups within this genus; it is also one of the rarest in collections (Sissom 2000). Originally recognized by Hoffmann (1931) as his “third section” of the genus, it was characterized by having the ventral submedian and ventrolateral carinae of metasomal segments I (or II) through IV well-developed and granular, and it included two species (one with three subspecies). Sologlad (1973) characterized this group based, among other characters, on the females having the genital opercula separated on the posterior fifth, and the basal position of chela trichobothria *ib-it*; he assigned eight species to it (three of which have since been transferred to the genus *Pseudouroctonus* Stahnke 1974). Sissom (1989) added six new species, and referred two others to the group. The same author (Sissom 2000) listed all the species assigned to that group up to 1998. Subsequently, Hendrixson and Sissom (2001) described two more taxa. The last three contributions cited mentioned that this group seems to be a widely distributed, heterogeneous assemblage of species that share the following characters: (1) six rows of denticles on the chela fixed finger, (2) the basal position of the *ib - it* trichobothria on the fixed finger, (3) stocky pedipalps, and (4) dark mottling on a brownish background color on most of the species. Since then the group received no attention until Graham (2007) described two species from the southwestern United States and placed them in this group. Sologlad & Fet (2008) assigned 28 species to the group, many of which do not belong here and will have to be re-assigned after a proper analysis (see Sissom 2000 for a preliminary discussion of the problem). Zárate-Gálvez & Francke (2009) recently described another new species from Chiapas. In addition to the characters mentioned above, and used by various authors to delimit the *mexicanus* group, we only consider as belonging to the group (= *mexicanus* group sensu stricto) those species in which (a) the spermatophore lacks a sclerotized mating plug, and (b) the telotarsus III distal spinule count is three (rarely) or higher (see McWest 2009). This restriction excludes *Vaejovis vorhiesi* Stahnke 1940 and its relatives (= group), found in mountains in the southwestern USA and northwestern Mexico, from the *mexicanus* group sensu stricto.

In recent years the number of species of scorpions from Oaxaca has increased from 25 reported by Lourenço & Sissom (2000) to 36 (Santibáñez-López et al., 2007), and Oaxaca is proving to be a region of high scorpion diversity (Francke 1977). The genus *Vaejovis* in Oaxaca is currently represented

by eight species: three assigned to the *eusthenura* group, three to the *mexicanus* group and two to the *nitidulus* group. The present contribution is the description of four new species of the *mexicanus* group, two of them from the Northern Mountain Range (Sierra Madre Oriental) from Oaxaca, one from the Mixteca region and the other from the Southern Mountain Range (Sierra Madre Occidental). Therefore, the new diversity figures for Oaxaca are: 40 species, 12 *Vaejovis*, and seven belonging to the *mexicanus* group. Furthermore, the males of two previously known species are described for the first time.

METHODS

Nomenclature and mensuration primarily follow Stahnke (1970), except for trichobothrial terminology after Vachon (1974), metasomal carinal terminology after Francke (1977) and pedipalp carinal terminology after Acosta et al. (2008). Hemispermatophores were dissected follow Vachon (1952), and cleared using the technique of Alvarez & Hormiga (2007); terminology after Sissom (1991). Granular, used primarily to refer to carinae, indicates a linear, bead-like arrangement of granules; granulose, used for carinae and for surfaces, indicates a primarily random scattering of granules. Higher scorpion classification follows Prendini & Wheeler (2005). Measurements were taken using an ocular micrometer calibrated at 10X with a Nikon SMZ800 stereoscope and are given in millimeters. Drawings were obtained with a camera lucida supported on the same stereoscope. Photographs were taken with a Nikon Coolpix S10 VR camera attached to the same stereoscope. Drawings and photographs were edited with Adobe Photoshop © C3. Geographical coordinates were obtained in the field with a Garmin eTrex GPS; missing geographic data were obtained from the Localities Historical Archive of the INEGI, online at <http://mapsver.inegi.org.mx/AHL/activaTiposBusqueda.do>, and using Google Earth. Maps were made with ArcView © Version 3.2. Map base taken from CONABIO (Online at <http://www.conabio.gob.mx/metacarto/metadatos.pl>). Abbreviations for measurements (all given in mm): L = length; W = width; D = depth; \bar{x} = average; \pm = standard deviation. Abbreviations for depositories: AMNH – American Museum of Natural History, New York; CNAN – Colección Nacional de Arácnidos, Instituto de Biología, Universidad Nacional Autónoma de México, México, D.F.; CALA – Colección Institucional “Luis de Armas” del Instituto Tecnológico del Valle de Oaxaca, Oaxaca, México.

Mesosomal sternite VII setal count.—Sissom (1989) was the first to mention the taxonomic relevance of this character; nevertheless he did not define a clear methodology to do it (e.g., the exclusion of marginal setae from the total count). Later, Hendrixson & Sissom (2001) reported the setae on the three species of their work, but they did not provide the methodology, either. Graham (2007) did not include this character in his descriptions. On many species of *Vaejovis*, stout, reddish macrosetae are associated with the submedian and lateral carinae, including the posterior margin of the sternite; but in the *mexicanus* group setae can also occur throughout the sternite. The only setae excluded from the counts reported in this paper are microsetae (= thin, colorless) and a few macrosetae that occur on the lateral margins of the sternite.

Metasomal setal count.—Setal counts in this region have been cited in previous descriptions, although variability has

not been properly analyzed. A preliminary analysis based on 128 specimens belonging to 10 different taxa indicates to us that these meristic characters are of limited taxonomic value in the *mexicanus* group (Francke & Santibáñez-Lopez, unpublished data) and are thus excluded from the specific diagnoses.

Telotarsus III distal spinule count.—Recently, McWest (2009) reported on the taxonomic usefulness of this character in vaejovid scorpions, based on a sample of numerous taxa, many of which were represented by one or few specimens. As pointed out by McWest (2009), telotarsus III seems to show the lowest variation. Hence we only considered the spinule count on that telotarsus. We consider it very important in the delimitation of the *mexicanus* group, and provide comprehensive counts for the seven species treated, to document the extent of intraspecific variation in this character.

KEY FOR THE IDENTIFICATION OF ADULTS OF OAXACAN SPECIES OF THE *MEXICANUS* GROUP

- | | |
|---|---|
| 1. Species with metasomal segment III wider than long. Sternites with strong, contrasting dusky pattern. Adults < 22 mm long | 2 |
| Species with metasomal segment III longer than wide. Sternites without dusky markings, or if present, weak to faint. Adults > 22 mm long | 4 |
| 2. Metasomal segment V L/W ratio 1.42–1.93 | 3 |
| Metasomal segment V L/W ratio 3.00 | <i>V. dzahui</i> sp. nov. |
| 3. Chela with eight granulose carinae (males unknown, data only from holotype female) | <i>V. nigrofemoratus</i> Hendrixson & Sissom 2001 |
| Chela with two carinae only, weakly granulose. | <i>V. franckei</i> Sissom 1989 |
| 4. Vesicle wider than posterior margin of metasomal segment V. Pedipalp chela fingers dentate margin on males with pronounced scalloping | <i>V. zapoteca</i> sp. nov. |
| Vesicle as wide as the posterior margin of metasomal segment V. Pedipalp chela fingers dentate margin on males straight, without scalloping | 5 |
| 5. Sternite VII with 11–12 setae. Chela with dorsal carinae moderate to strong, granulose | <i>V. darwini</i> sp. nov. |
| Sternite VII with > 15 setae. Chela with dorsal carinae weak, granulose. | 6 |
| 6. Pectinal tooth count on males = 18–20, on females = 17–18 | <i>V. prendinii</i> sp. nov. |
| Pectinal tooth count on males = 15–16, on females = 13–15 | <i>V. setosus</i> Sissom 1989 |

SYSTEMATICS

Family Vaejovidae Thorell 1876

Genus *Vaejovis* C.L. Koch 1836

Vaejovis C.L. Koch 1836:51.

Type species.—*Vaejovis mexicanus* C.L. Koch 1836 by monotypy.

Vaejovis setosus Sissom 1989

(Figs. 2–8)

Vaejovis setosus Sissom 1989:152–154, 157, figs. 62–64, 66–71; Kovařík 1998:148; Sissom 2000:543; Soleglad & Fet 2008:100.

Type data.—MEXICO: *Oaxaca*: holotype female, Distrito Tlacolula, 3 mi SE of Tlacolula (16°56.000'N, 96°25.000'W), 30 August 1966, J. and W. Ivie (AMNH, not examined); 1 paratype female, Tlacolula, 16 June 1955, C. and P. Vaurie (AMNH, examined).

Material examined.—MEXICO: *Oaxaca*: 2♂, 3♀, 4 subadult ♂ and 2 juvenile ♀, Distrito Ixtlan de Juarez, km 45.8 federal road 175, Oaxaca-Ixtlan de Juarez (17°17.834'N, 96°32.582'W, elev. , masl), 14 June 2007, A. Valdez and C. Santibáñez (CNAN); 1♂, 1♀, same data (AMNH); 1♂, 1♀, 2 km road to San Juan Chicomezuchil, (17°17.697'N, 96°29.980'W, elev. 1,584 masl), 15 June 2007, A. Valdez and C. Santibáñez

(CNAN); 4♀, Km 171 road Ixtlan de Juarez-Oaxaca (17°17.835'N, 96°32.577'W, elev. 2,006 masl), 16 March 2008, A. Valdez, H. Montaña and C. Santibáñez (CNAN); 2♀, Distrito Mixes, Santa María Tlahuitoltepec, (17°01.037'N, 96°01.915'W, elev. 2,459 masl), 20 July 2007, O. Francke, A. Ballesteros, H. Montaña, C. Santibáñez and A. Valdez (CNAN); 1 ♀, Distrito Tlacolula, Yagul 30 km, 13 August 1988, S. Stockwell (AMNH).

Diagnosis.—Adults 17–28 mm long. Base color yellow brown with strong blackish markings on tergites, metasoma and appendages; chelicerae with dusky markings limited to distal margin. Pectinal tooth count on males 15–16 (mode = 15), on females 13–15 (mode = 14). Sternite VII with 16–21 setae (mode = 20). Segment V length/width mean = 1.85 (± 0.09) in females and mean = 2.07 (± 0.20) in males. Vesicle width/segment V posterior width mean = 1.23 (± 0.12) in females and mean = 1.25 (± 0.08) in males. Pedipalps: dorsal surfaces of femur and tibia finely granulose; patella with retrodorsal carina weak, smooth. Dentate margin of pedipalp fingers straight on both sexes. Dentate margin of movable finger with six subrows of denticles, with seven inner denticles. Telotarsus III with one ventromedial row of spinules bifurcating distally with 4–6 (mode = 2 pairs) spinules.

Appears most similar to *V. darwini* sp. nov. and *V. prendinii* sp. nov., which share a relatively large size (adults > 22 mm

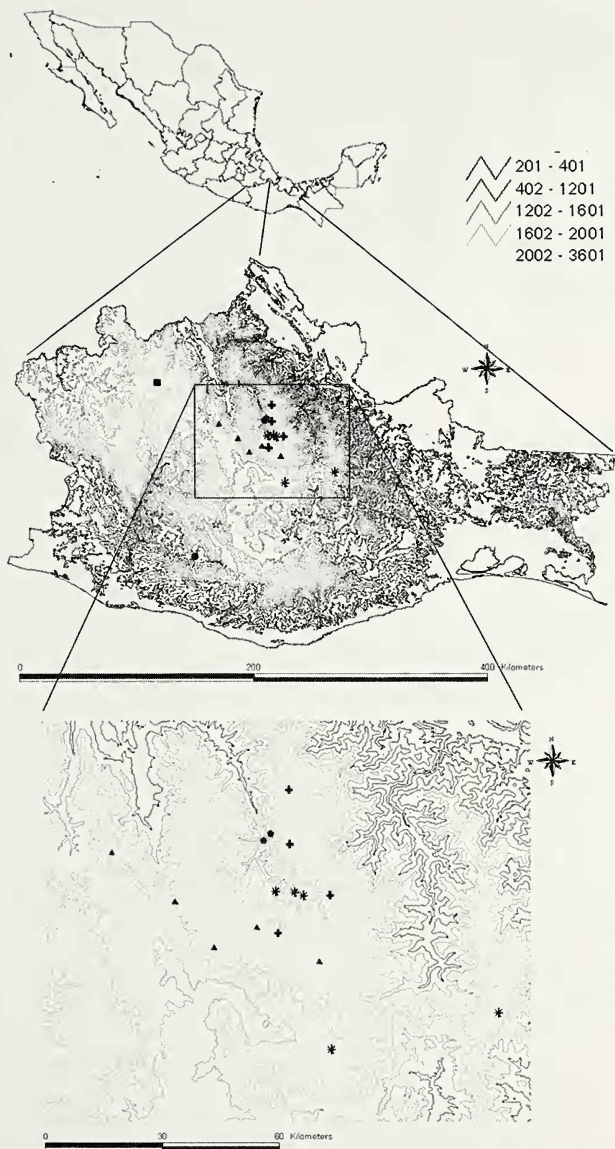
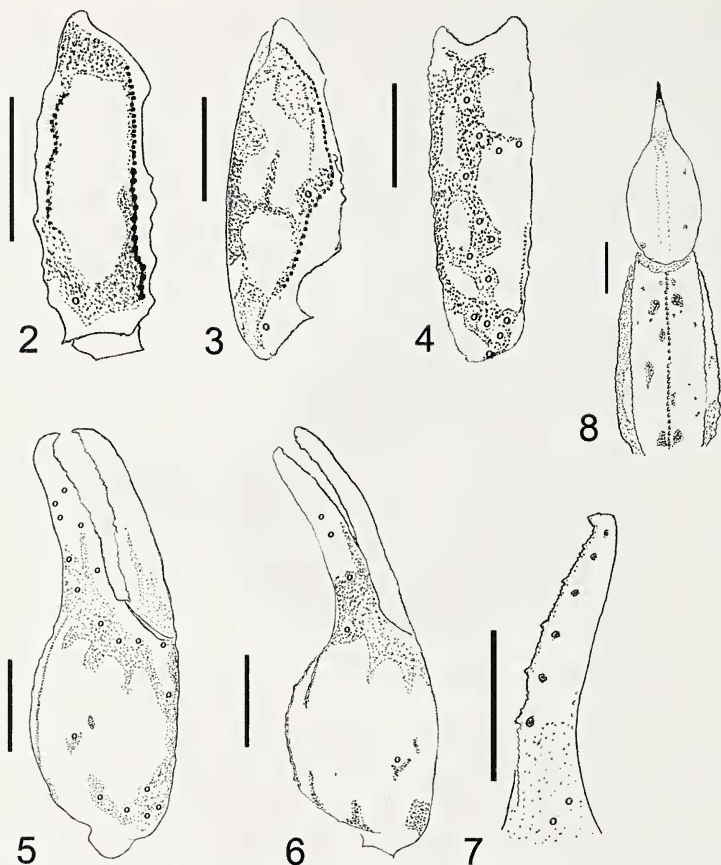


Figure 1.—Distribution of the species of the "mexicanus" group of the genus *Vaejovis* Koch 1836 in Oaxaca, Mexico. *V. setosus* (*); *V. franckei* (▲); *V. prendinii* (●); *V. zapoteca* (+); *V. dzahui* (■); and *V. darvini* (●). The outline represents the Northern Mountain Range of Oaxaca. Elevation ranges in meters.



Figures 2-8.—*Vaejovis setosus* Sissom, male (from km 45.8 federal road 175, Oaxaca-Ixtlan de Juarez): 2. Right femur, dorsal view; 3. Right patella, dorsal view; 4. Right patella, retrolateral view; 5. Right chela, retrodorsal view; 6. Right chela, dorsal view; 7. Fixed finger, ventral view; 8. Metasomal segment V, ventral view. Scale bars = 1 mm.

long), metasomal segment III is longer than wide, and the lack of infuscations on the sternites. *V. darwini* sp. nov. has fewer setae on sternite VII (11-12) and a higher pectinal tooth counts (males 17, females 15-16); and *V. prendinii* sp. nov. also has a higher pectinal tooth count (males 18-20, females 17-18).

Description of male.—*Coloration*: Base color yellow brown with moderately strong dusky pattern (as female, see Sissom 1989).

Prosoma: Anterior margin of carapace weakly concave; surface sparsely granulose.

Mesosoma: Tergites sparsely, coarsely granular; shagreened. Tergites I-IV: median carina on I obsolete, on II-VI weak, granulose. Submedian carinae on I-II vestigial; on III-V weak, granulose; on VI moderate, granular. Tergite VII:

median carina present on anterior two-thirds; submedian and lateral carinae strong, granular. Genital papillae well developed. Pectinal tooth count 15-15. Sternites III-VI smooth to shagreened medially; weakly to moderately setose. Sternite VII with one pair of weak, granular lateral carinae. Sternite VII with 16 setae.

Metasoma: Segments I-IV. Carination: Dorsolateral carinae on I strong, serrate to crenulate; on II-IV strong, crenulate. Lateral suprmedian carinae on I-III strong, crenulate; on IV strong, crenulate to granular. Lateral inframedian carinae on I strong, granular; on II present only on posterior two-thirds, strong, granular to crenulate; on III present only on posterior half, strong to moderate, crenulate; on IV absent. Ventrolateral carinae on I moderate, irregularly crenulate; on II-IV strong, irregularly crenulate. Ventral

Table 1.—Variation in the pectinal tooth count in the eight species of the *Vaejovis* "mexicanus" group.

Species	Sex	10	11	12	13	14	15	16	17	18	19	20
<i>V. setosus</i>	male						12	2				
	female				8	9	1					
<i>V. franckei</i>	male			3	12	3						
	female	2	5									
<i>V. prendinii</i> sp. nov.	male									1	3	4
	female								2	2		
<i>V. zapoteca</i> sp. nov.	male			8	33	11	3					
	female		1	12	5	4						
<i>V. dzahui</i> sp. nov.	male				8	10	2					
	female			5	3							
<i>V. darwini</i> sp. nov.	male								6			
	female						1	3				
<i>V. pusillus</i>	male		2	2								
	female	2	4									
<i>V. granulatus</i>	male						1	3	4	2		
	female					4	5	1				

submedian carinae on I obsolete; on II weak, feebly granular; on III moderate, crenulate; on IV strong, irregularly crenulate. Intercarinal spaces shagreened. Segment V: Dorsolateral carinae strong, granular to serrate; lateral carinae moderate, granular to crenulate; ventrolateral carinae strong, granular to crenulate; ventromedian carina strong, granular to crenulate. Intercarinal spaces shagreened.

Telson: Vesicle wider than posterior margin of segment V (Fig. 8); ventral surface irregularly granular, with 4 pairs of setae; subtle subaculear tooth preceded by a few small granulations.

Pedipalps: Orthobothriotic "C". Femur (Fig. 2): Dorsal surface with some coarse granulation, shagreened. Prodorsal carina moderate, granular to crenulate. Retrodorsal carina moderate to weak, granular. Proventral carina strong, granular. Retroventral carina weak, smooth. Setation (right/left): prodorsal carinae with 5/6 setae, 5/5 medial setae on prolateral face; retroventral carinae with 3/4 setae. Patella (Figs. 3, 4) with retrodorsal carina weak, smooth; prodorsal carina moderate, granular to crenulate; retroventral carina obsolete to faint, smooth; proventral carina weak, granular. Setation (right/left): prolateral face with 5/4 (right/left) setae. Chela (Figs. 5, 6) slender; dentate margins of fingers straight. Dorsal marginal, prodorsal, dorsal secondary and prolateral carinae weak, smooth; all other carinae obsolete. Fixed finger (Fig. 7) with primary denticle row divided into six subrows by five enlarged primary row denticles; six inner denticles. Movable finger with primary row divided into six subrows by five enlarged primary row denticles; seven inner denticles.

Legs: Basitarsus I with two ventrosabmedian rows of spinules. Basitarsus II with one ventrosabmedian row of spinules divided by 3 large setae. Basitarsi III–IV with one ventrosabmedian row of spinules divided by 4 large setae. Telotarsus III with one ventromedian row of spinules bifurcating distally, with four spinules (2 pro- and 2 retrolateral) on each leg.

Hemispermaphore: (Figs. 44, 45). Lamelliform; hooks basal, short, bifurcate; lamella thick and curved; no sclerotized hemi-mating plug.

Measurements: Total L, 21.5; carapace L, 3.1; mesosoma L, 5.6; metasoma L, 10.5. Metasomal segments: I L/W, 1.5/1.9; II

L/W, 1.6/1.9; III L/W, 1.8/1.9; IV L/W, 2/1.8; V L/W/D, 3.6/1.7/1.7. Telson: Vesicle L/W/D, 2.3/1.4/1.1. Pedipalp: Total L, 9.7; femur L, 2.3; patella L/W, 2.9/0.9; chela L/W/D, 4.5/1.4/1.6; fixed finger L, 2.1; movable finger L, 2.8.

Variation: *Vaejovis setosus* shows no marked sexual dimorphism except in genital and pectinal characters, as shown by other congeners. Pectinal tooth count variation in Table 1. Sternite VII setae count ($n = 20$) 16–21 (mode = 20). There was no variation in the pedipalp chela finger dentition, all specimens have six subrows of denticles on both fingers; on the fixed finger all specimens have six inner accessory denticles, whereas on the movable finger all have seven. Telotarsus III distal spinule count ($n = 24$) 1 telotarsus with 3 spinules (1 pro- and 2 retrolateral), 19 with 4 (2 + 2) spinules, 3 with 5 (2 + 3) spinules and 1 with 6 (3 + 3) spinules.

Morphometric ranges: Males ($n = 7$): Chela L/W, 3.13–4.13; patella L/W, 2.70–3.33; fixed finger L/chela L, 0.11–0.49; segment V L/W, 1.64–2.22; vesicle W/posterior margin of segment V, 1.14–1.56. Females ($n = 9$): Chela L/W, 3.50–4.08; patella L/W, 2.73–3.43; fixed finger L/chela L, 0.44–0.54; segment V L/W, 1.65–2.00; vesicle W/posterior margin of segment V, 1.09–1.40.

Distribution.—This species is known from the central mountains of Oaxaca and the Sierra Juarez (Ixtilan de Juarez district) (Fig. 1).

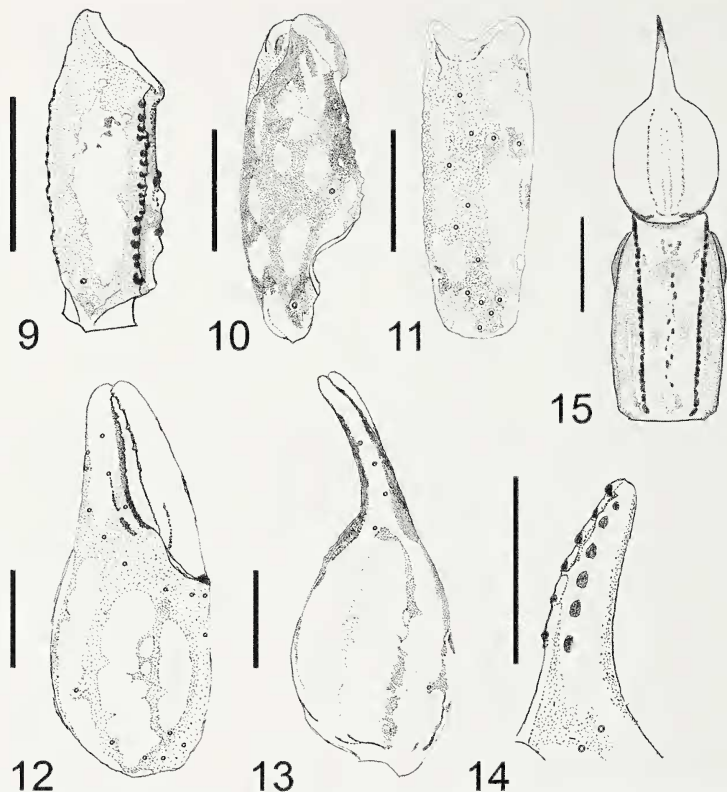
Vaejovis franckei Sissom 1989

(Figs. 9–15)

Vaejovis franckei Sissom 1989:150–152, 157, figs. 54–61; Kovařík, 1998:146; Sissom, 2000:540; Sologlad & Fet, 2008:99.

Type data.—MEXICO: Oaxaca: holotype female, Distrito Etla, Sierra Aloapaneca, 8–18 mi (via road) NNE of San Juan del Estado (17°16.446'N, 96°47.918'W, elev. 8,400–9,700 ft), 5 August 1966, C.M. and M.R. Bogert (AMNH, examined); 2 paratype females, Distrito Ixtlan de Juarez, El Punto, N of Continental Divide on road to Guelatao (17°13.025'N, 96°35.096'W, elev. 7,000–7,500 ft), 28 June 1967, M.R. Bogert (AMNH, not examined).

Other material examined.—MEXICO: Oaxaca: 4♂, 4♀, Distrito Ixtlan de Juarez, 6 km W Llano Grande, San Antonio



Figures 9–15.—*Vaejovis franckei* Sissom, male (from 6 km W of Llano Grande, San Antonio Cuajimoloyas): 9. Right femur, dorsal view; 10. Right patella, dorsal view; 11. Right patella, retrolateral view; 12. Right chela, retrodorsal view; 13. Right chela, dorsal view; 14. Fixed finger, ventral view; 15. Metasomal segment V, ventral view. Scale bars = 1 mm.

Cuajimoloyas (17°08.109'N, 96°26.576'W, elev. 3,134 masl), 20 June 2007, A. Valdez and C. Santibáñez, (CNAN); 2♂, 1♀, same data (AMNH); 5♂, 1♀, Distrito Etlá, 10 km E San Pablo Etlá (17°10.01'N, 96°41.11'W, no elevation), 3 March 2006, C. Santibáñez (CNAN); 1♂, La Carbonera, Telixtlahuaca (17°17.043'N, 96°56.238'W, no elev.), no collector (AMNH).

Diagnosis.—Adults 19–26 mm long. Base color yellow brown with strong blackish markings on tergites, sternites, metasoma and appendages; chelicerae with dusky markings limited to distal margin. Pectinal tooth count on males 12–14 (mode = 13), on females 10–11 (mode = 11). Sternite VII with 10–12 setae (mode = 10). Metasomal segments short and wide, vesicle width/segment V posterior width mean = 1.36 (\pm 0.18) in females and mean = 1.30 (\pm 0.16) in males. Lateral faces of metasomal segment V strongly convex. Pedipalps: retrodorsal carina of patella obsolete; retroventral carina obsolete or weak, smooth; sexual dimorphism present, with chela on

males rounder than on females; dentate margin of movable finger divided into six subrows, with seven inner denticles. Telotarsus I–V with one ventromedian row of spinules bifurcating distally, with 4–6 (mode = 4) spinules.

Vaejovis franckei may be distinguished from *V. setosus* by the following characters: (1) metasomal segment V length/width ranges from 1.42–1.59 (not 1.76–1.86); (2) metasomal segment I dorsolateral carinae and lateral supramedian carinae are flanked in *V. setosus* by one seta (*V. franckei* is flanked by none); (3) sternite VII possesses 10–12 setae (16–20 in *V. setosus*); (4) cuticular surfaces, especially the carapace, metasoma, and pedipalps, are densely and coarsely granulate (at most, sparsely coarsely granulate in *V. setosus*); (5) pectinal tooth counts of 13–15 on females of *V. setosus* (not 10–11 as in *V. franckei*); (6) smaller body size; (7) on males the pedipalp chela is rounded with fingers shorter than the manus, whereas on *V. setosus* the chela is slender and it has fingers longer than the manus.

Description of male.—*Coloration:* Base color yellow brown; fuscous markings on tergites, metasoma and appendages strong; ventrally base color light yellow to light brown; sternites and pectines heavily mottled. Chelicerae with dusky markings limited to distal margins; most of cheliceral dorsal surface creamy yellow.

Prosoma: Anterior margin of carapace straight to weakly emarginated; surface around median eyes densely, finely granular interspersed with scattered coarse granules.

Mesosoma: Tergites sparsely, coarsely granulose; shagreened. Tergites I–VI: median carina on I obsolete, on II–VI weak, feebly granulose. Submedian carinae on I–II vestigial; on III–V weak, granular; on VI moderate, granular. Tergite VII: median carina present on anterior two-thirds; submedian and lateral carinae strong, granulose. Genital papillae well developed. Sternites III–VI smooth to shagreened medially, with dusky markings; sparsely setose. Sternite VII with one pair weak, feebly granulose lateral carinae. Sternite VII with 10 setae. Pectinal tooth count 13–13.

Metasoma: Segments I–IV: intercarinal spaces densely, coarsely granulose. Dorsolateral carinae on I strong, granular to crenulate; on II–IV strong, crenulate. Lateral supramedian carinae on I–III strong, crenulate; on IV strong, crenulate to granular. Lateral inframedian carinae on I strong, granular; on II present only on posterior half, strong, granular to serrate; on III present only on distal one-third, strong, serrate; on IV absent. Ventrolateral carinae on I moderate, irregularly crenulate; on II–IV strong, irregularly crenulate. Ventral submedian carinae on I obsolete; on II weak, granular; on III moderate, granular to crenulate; on IV strong, irregularly crenulate. Segment V: Dorsolateral carinae moderate, granular to crenulate; lateral carinae weak to moderate, granular; ventrolateral carinae strong, granular to crenulate; ventromedian carina moderate to strong, granular to crenulate. Intercarinal spaces densely, coarsely granular.

Telson: Vesicle 1.33 wider than the posterior margin of segment V; ventral surface irregularly granulose, with 4 pairs of setae (Fig. 15).

Pedipalps: Orthobothriotaxic "C". Femur (Fig. 9): Dorsal surface densely, finely granulose with some coarse granulation. Prodorsal carina strong, granular to crenulate. Retrodorsal carina moderate to weak, granular. Proventral carina weak, granular. Retroventral carina weak, smooth. Setation (right/left): prodorsal carinae with 4/4, 2/2 medial setae on prolateral face; retroventral carinae with 3/3. Patella (Figs. 10, 11) with retrodorsal carina obsolete; prodorsal carina moderate, crenulate to smooth; retroventral carina obsolete to faint, smooth; proventral carina weak, granular. Setation (right/left): 4/4 prodorsal setae. Chela (Figs. 12, 13) rounded, short. Digital, prodorsal, dorsal secondary and prolateral carinae weak, smooth; all other carinae obsolete. Fixed finger (Fig. 15) with primary row divided into six subrows by five enlarged primary row denticles; six inner denticles. Movable finger with primary row divided into six subrows by five enlarged primary row denticles; seven inner denticles.

Legs: Basitarsus I with two ventrosupramedian rows of spinules. Basitarsus II with one ventrosupramedian row of spinules divided by 3 large setae. Basitarsus III–IV with one ventrosupramedian row of spinules divided by 4 large setae. Telotarsus III with one ventromedial row of spinules

bifurcating distally with four spinules (2 pro- and 2 retro-lateral) on each leg.

Hemispermatothore: Lamelliform; hooks basal, short; lamella thick and curved; no sclerotized hemi-mating plug (Figs. 46, 47).

Measurements: Total L, 19.5; carapace L, 2.6; mesosoma L, 6.5; metasoma L, 8.4. Metasomal segments: I L/W, 1/1.8; II L/W, 1.3/1.7; III L/W, 1.4/1.7; IV L/W, 1.8/1.7; V L/W/D, 2.9/1.8/1.4. Telson: Vesicle L/W/D, 2/1.6/1.1. Pedipalp: Total L, 8.6; femur L, 2; patella L/W, 2.4/0.9; chela L/W/D, 4.2/1.4/1.7; fixed finger L, 1.6; movable finger L, 2.4.

Variation.—*Vaejovis franckei* shows marked sexual dimorphism on pedipalps: males with chela rounded, whereas on females they are slender. Pectinal tooth count variation in Table 1. Sternite VII setae count ($n = 20$) 10–12 (mode = 12). Pedipalp chela finger dentition ($n = 20$) for the right fixed finger, 18 fingers have 6 subrows of denticles and 2 have 5 subrows; 20 fingers have 6 inner accessory denticles. For the right movable finger, 20 fingers have 6 subrows of denticles; 20 fingers have 7 inner accessory denticles. Telotarsus III distal spinule count ($n = 28$): 24 with 4 (2 + 2), 3 with 5 (2 + 3) and 1 with 6 (3 + 3) spinules.

Morphometric ranges: Males ($n = 9$): Chela L/W, 2.56–3.00; patella L/W, 2.22–3.14; fixed finger L/chela L, 0.35–0.44; segment V L/W, 1.42–1.93; vesicle W/posterior margin of segment V, 1.08–1.55. Females ($n = 4$): Chela L/W, 3.60–3.90; patella L/W, 2.44–2.67; fixed finger L/chela L, 0.44–0.47; segment V L/W, 1.44–1.59; vesicle W/posterior margin of segment V, 1.17–1.55.

Distribution.—This species is known from the central mountains from Oaxaca and the Sierra Juarez (Distritos Ixtlan de Juarez and Etla) (Fig. 1).

Vaejovis prendinii sp. nov.

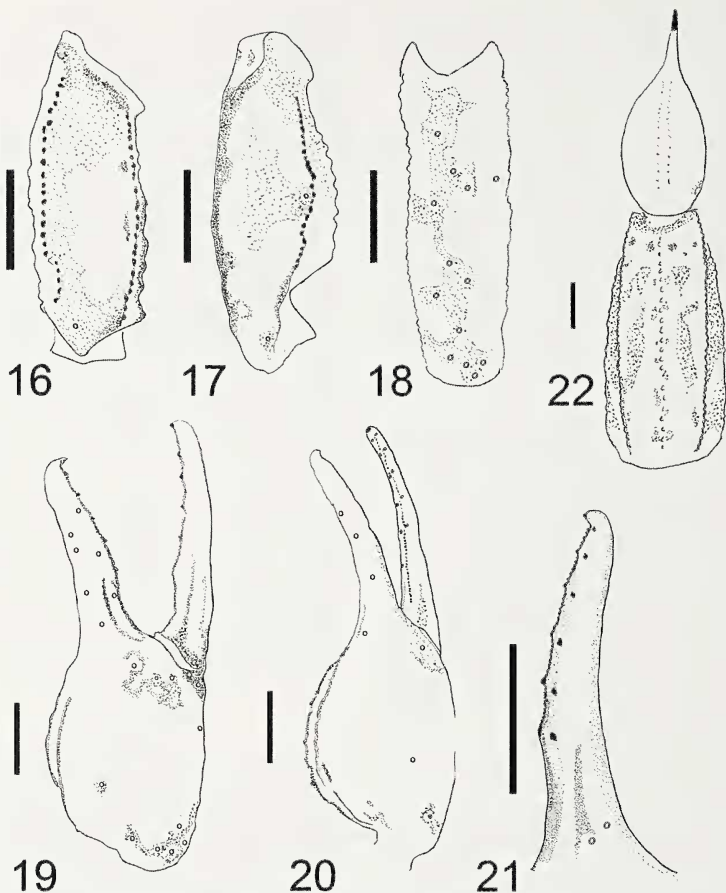
(Figs. 16–22)

Type data.—MEXICO: Oaxaca: holotype male, Distrito Ixtlan de Juarez, Rio Grande, San Juan Atepec (17°24.837'N, 96°34.265'W, elev. 1,327 masl), 3 July 2008, O. Francke, A. Quijano and C. Santibáñez (CNAN-T0378). Paratypes: 1 male, 1 female, collected with holotype (CNAN-T0379); 1 female, collected with holotype (AMNH); 1 male, 2 km NW of San Juan Atepec (17°25.774'N, 96°33.314'W, elev. 1,849 masl), 4 July 2008, O. Francke, A. Quijano and C. Santibáñez (CNAN-T0380).

Other material examined.—MEXICO: Oaxaca: 1♂, Distrito Ixtlan de Juarez, Ixtlan de Juarez (17°19.596'N, 96°28.891'W, no elev.), no date, no collector (CNAN-S00628); 1 juvenile, Ixtlan de Juarez (17°19.596'N, 96°28.891'W, no elev.), 24 April 2004, G. Linares (CALA).

Etymology.—The specific epithet is a patronym honoring Dr. Lorenzo Prendini (AMNH) for his contributions to scorpion systematics.

Diagnosis.—Adults 25–34 mm long. Sexual dimorphism present; males with weak scalloping in the fingers on the pedipalp chela. Sternite VII with 20–23 setae (mode = 22). Pectinal tooth count: males 18–20 (mode = 20), and females 17–18 (mode = 17–18). Vesicle width/segment V posterior margin mean = 1.19 (± 0.15) in males. Dentate margin of movable finger of pedipalp chela with six subrows of denticles, seven inner denticles.



Figures 16-22.—*Vaejovis prendinii* sp. nov., holotype male: 16. Right femur, dorsal view; 17. Right patella, dorsal view; 18. Right patella, retrolateral view; 19. Right chela, retrodorsal view; 20. Right chela, dorsal view; 21. Fixed finger, ventral view; 22. Metasomal segment V, ventral view. Scale bars = 1 mm.

Vaejovis prendinii is most similar to *V. franckei*, from which it can be distinguished by: (1) metasomal segments proportionately shorter in *V. franckei*; (2) sternite VII with 20-23 setae (10 setae on *V. franckei*.); (3) metasomal carinae more hirsute than in *V. franckei*; (4) pectinal tooth count on males considerably higher (18-20; mode = 20) whereas on *V. franckei* it is lower (12-14); on females also significantly higher 17-18, whereas on *V. franckei* 10-11.

Vaejovis prendinii can be distinguished from *V. setosus* by: (1) pectinal tooth count in males = 18-20 (mode = 20) on *V. prendinii*, whereas in *V. setosus* on males = 15-16 (mode = 15); (2) adults bigger than *V. setosus*; (3) sternite VII with 20-23 setae (mode = 22), whereas *V. setosus* has 16-21 setae (mode = 20); (4) males with chela

globose, whereas on *V. setosus* it is slender (see Figs. 5, 6, 19, 20).

Vaejovis prendinii is also similar to *V. granulatus* but it is distinguished by: (1) pectinal tooth count on males = 18-20 (mode = 20), whereas on *V. granulatus* it is 15-19 (mode = 18); (2) metasomal dorsolateral carinae on segment I flanked by three setae, whereas on *V. granulatus* it is flanked by two; (3) pedipalp chela movable finger dentition divided into 6 subrows with 7 inner accessory granules (5 subrows with 6 inner accessory granules on *V. granulatus*); (4) Sternite VII with 20-23 setae (10 setae on *V. granulatus*).

Description of holotype male.—*Coloration:* Body base color yellow brown with moderately strong dusky pattern, pedipalp chela light orange with the finger tips brown.

Prosoma: Anterior margin of carapace weakly concave, entire surface shagreened, sparsely granulose.

Mesosoma: Tergites shagreened. Tergites I–VI: median carina on I–II obsolete, on III–VI weak, granulose. Submedian carinae on I–II vestigial, on III–IV weak, granulose, on V–VI moderate, granular. Tergite VII: median carina present on anterior two-thirds, submedian and lateral carinae strong, granular. Genital papillae developed. Pectinal tooth count 19–19. Sternites III–VI smooth to shagreened medially, moderately to densely setose. Sternite VII with submedian carinae weak, smooth to feebly crenulate; lateral carinae weak, granular. Sternite VII with 22 setae.

Metasoma: Segments I–IV: dorsolateral carinae on I–II strong, granular; on III–IV strong, granular to crenulate. Lateral supramedian carinae on I–III strong, crenulate to serrate; on IV moderate, crenulate to granular. Lateral supramedian carinae on I–III strong, crenulate; on IV moderate, crenulate to granular. Lateral inframedian carinae on I strong, granular; on II present only on posterior half, moderate, granular to crenulate; on III present only on posterior one-third, moderate, crenulate; on IV absent. Ventrolateral carinae on I strong, granular to crenulate; on II–IV strong, irregularly crenulate. Ventral submedian carinae on I weak, smooth to crenulate; on II–III moderate, granular to crenulate; on IV strong, crenulate. Intercarinal spaces shagreened. Segment V: dorsolateral carinae moderate, crenulate to serrate; lateral carinae weak, present only on anterior half, crenulate; ventrolateral carinae strong, crenulate; ventromedian carina moderate, granular; intercarinal spaces shagreened.

Telson: Vesicle as wide as posterior margin of segment V; ventral surface with 12 setae (Fig. 22).

Pedipalps: Orthobothriotic "C". Femur (Fig. 16): Dorsal surface with few coarse granulations, shagreened. Prodorsal carina strong, granular. Retrodorsal carina moderate to weak, crenulate. Proventral carina moderate, granular. Retroventral carina weak to moderate, feebly granular. Setation (right/left): prodorsal carinae with 3/3 setae, 3/3 medial setae on prolateral face; retroventral carinae with 4/4 setae. Patella (Figs. 17, 18) with retrodorsal carina weak, smooth; prodorsal carina moderate, granular to crenulate; retroventral carina obsolete to faint, smooth; proventral carina moderate, granular. Setation (right/left): 5/6 setae on prolateral face. Chela (Figs. 19, 20) with weak scalloping on the fingers. Digital, prodorsal, dorsal secondary and retrolateral carinae weak, crenulate to smooth; two prolateral carinae present (dorsal and ventral), dorsal weak to moderate, granular; ventral weak, smooth to feebly crenulate; all other carinae obsolete. Fixed finger (Fig. 21) with primary row divided into six subrows by five enlarged primary row denticles; six inner denticles. Movable finger with primary row divided into six subrows by five enlarged primary row denticles; distal-most row very short with a single denticle; seven inner denticles.

Legs: Basitarsus I–III with two ventrosupramedian rows of spinules, divided by four large setae. Basitarsus IV with two ventrosupramedian rows of four setae. Telotarsus III with ventromedian row of spinules bifurcating distally, with five spinules (2 pro- and 3 retrolateral) on one leg, and four spinules (2 pro- and 2 retrolateral) on the other leg.

Hemispermatophore: Lamelliform; hooks basal, short; lamella straight and wide; no sclerotized hemi-mating plug (Figs. 48, 49).

Measurements: *Holotype male*: Total L, 30.4; carapace L, 3.7; mesosoma L, 9.2; metasoma L, 14.6. Metasomal segments: I L/W, 1.9/2.4; II L/W, 2.2/2.2; III L/W, 2.4/2.2; IV L/W, 3.2/2.2; V L/W/D, 4.9/2.3/2. Telson: Vesicle L/W/D, 2.9/1.8/1.3. Pedipalp: Total L, 13.2; femur L, 3.3; patella L/W, 3.6/1.1; chela L/W/D, 6.3/1.8/2.1; fixed finger L, 2.4; movable finger L, 3.6.

Paratype female: Total L, 32.5; carapace L, 4.3; mesosoma L, 11.6; metasoma L, 13.8. Metasomal segments: I L/W, 1.8/2.6; II L/W, 2.1/2.5; III L/W, 2.3/2.5; IV L/W, 3.2/2.4; V L/W/D, 4.4/2.3/2.1. Telson: Vesicle L/W/D, 2.8/1.9/1.6. Pedipalp: Total L, 13.8; femur L, 3.4; patella L/W, 3.8/1.1; chela L/W/D, 6.6/1.7/1.9; fixed finger L, 2; movable finger L, 4.1.

Variation.—*Vaejovis prendinii* exhibits some sexual dimorphism: males with weak scalloping present in the fixed fingers; males with proportionately longer metasomal segments than females. Pectinal tooth count variation in Table 1. Sternite VII setae count ($n = 5$) 20 to 23 (mode = 22). On the pedipalp chela fixed finger all specimens have six subrows and six inner accessory denticles; on the movable finger all specimens have six subrows (distal most always very short with only one or two denticles) and seven inner accessory denticles. Telotarsus III distal spinule count ($n = 5$): 7 with 4 (2 + 2) and 3 with 5 (2 + 3) spinules.

Morphometric ranges: Males ($n = 4$): Chela L/W, 2.95–3.50; patella L/W, 3.09–3.33; fixed finger L/chela L, 0.38–0.41; segment V L/W, 2.00–2.20; vesicle W/posterior margin of segment V, 1.00–1.33. Females ($n = 2$): Chela L/W, 3.53–3.88; patella L/W, 3.45–3.55; fixed finger L/chela L, 0.30–0.50; segment V L/W, 1.91–2.04; vesicle W/posterior margin of segment V, 1.19–1.20.

Distribution.—This species is known from the type locality, and one additional locality nearby, in Ixtlan district (Fig. 1).

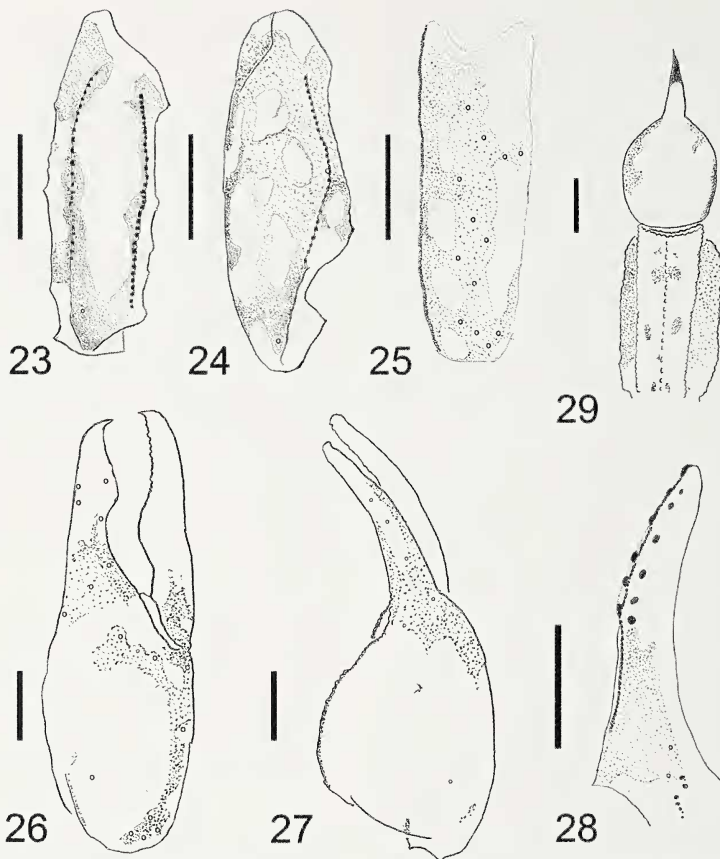
Vaejovis zapoteca sp. nov.

(Figs. 23–29)

Vaejovis franckei: Mondragon & Cruz-Ruiz, 2009:371 (misidentification).

Type data.—MEXICO: *Oaxaca*: holotype male, Distrito Ixtlan de Juarez, Puerta del Sol, San Pablo Macuilanguis (17°31.722'N, 96°33.678'W, elevation 2,742 masl), 13 November 2005, O. Francke, G. Montiel, M. Córdova, A. Jaimes and C. Santibáñez (CNAN-T0381). Paratypes: 5 males, 2 females, collected with holotype (CNAN-T0382); 5 males, 1 female, collected with holotype (AMNH).

Other material examined.—MEXICO: *Oaxaca*: 15♂, 3♀, Distrito Ixtlan de Juarez, Campamento Tatachinto, Santiago Xiacui (17°17.254'N, 96°25.058'W, elev. 2,313 masl), 22 July 2007, O. Francke, A. Ballesteros, H. Montaño, C. Santibáñez and A. Valdez (CNAN); 5♂, 1 km 137 road Oaxaca-Tuxtepec (17°24.292'N, 96°30.595'W, elev. 2,789 masl), 23 July 2007, O. Francke, A. Ballesteros, H. Montaño, C. Santibáñez and A. Valdez (CNAN); 2♂, 5♀, 1 km E Campamento del Monte, El Punto, Santa Catarina Ixtepeji (17°11.704'N, 96°35.898'W, elev. 2,537 masl), 17 March 2008, H. Montaño, C. Santibáñez and A. Valdez (CNAN).



Figures 23–29.—*Vaejovis zapoteca* sp. nov., holotype male: 23. Right femur, dorsal view; 24. Right patella, dorsal view; 25. Right patella, retrolateral view; 26. Right chela, retrorodorsal view; 27. Right chela, dorsal view; 28. Fixed finger, ventral view; 29. Metasomal segment V, ventral view. Scale bars = 1 mm.

Etymology.—The specific epithet is derived from the name of the Zapoteca culture, which inhabits the area of distribution of this species; it is used as a noun in apposition.

Diagnosis.—Adults 28–30 mm long. Sexual dimorphism present on pedipalp chela, males with swollen pedipalp chelae and pronounced scalloping in the fingers. Sternite VII with 10–11 setae (mode = 10), Pectinal tooth count on males 12–15 (mode = 13), on females 11–14 (mode = 12). Vesicle width/segment V posterior margin mean = 1.58 (± 0.09) in males. Pedipalp chela movable finger with 6 subrows of denticles divided by 5 enlarged denticles, 7–10 (mode = 8) inner denticles.

Vaejovis zapoteca is similar to *V. franckei* but it differs as follows: (1) sternites with strong dusky markings, whereas on *V.*

zapoteca with faint to obsolete dusky marking pattern; (2) vesicle width/posterior margin of metasomal segment V is mean = 1.30 (± 0.16) in males of *V. franckei*, whereas in *V. zapoteca* mean is = 1.58 (± 0.09); (3) pedipalp movable finger with 6 subrows in *V. franckei*, whereas on *V. zapoteca* there are 5 subrows; (4) pedipalp movable finger with 6 inner accessory denticles in *V. franckei*, whereas on *V. zapoteca* there are usually more than 6 (see intraspecific variation above).

Vaejovis zapoteca may be distinguished from *V. setosus* as follows: (1) males with scalloping pronounced on the pedipalp chela fingers, whereas on *V. setosus* it is absent; (2) pectinal tooth count on males = 12–15 (mode = 13), whereas on *V. setosus* 15–16 (mode = 15); (3) dorsolateral carinae on segment I with one seta (two setae on *V. setosus*); (4) sternite

VII with 10–11 setae (mode = 10) on *V. zapoteca* (16–21, mode = 20 on *V. setosus*); (5) vesicle width/posterior margin of metasomal segment V in *V. zapoteca* males mean = 1.58 (\pm 0.09), whereas in *V. setosus* mean = 1.25 (\pm 0.08); (6) movable finger on *V. setosus* with six inner accessory denticles, whereas on *V. zapoteca* there are usually 8–9 inner accessory denticles.

Vaejovis zapoteca is also similar to *V. prendinii* and it may be separated by the following characters: (1) males with pedipalp chela fingers with scalloping pronounced in *V. zapoteca*, whereas on *V. prendinii* they are weakly scalloped; (2) pectinal tooth count on males 12–15 (mode = 13) (18–20, mode = 20 on *V. prendinii*); (3) sternite VII with 20–23 (mode = 22) setae on *V. prendinii*, whereas on *V. zapoteca* with 10–11 (mode = 10); (4) vesicle width/posterior margin of metasomal segment V in males mean = 1.58 (\pm 0.09), whereas in *V. prendinii* mean = 1.19 (\pm 0.15); (5) pedipalp chela movable finger with 8–9 inner denticles (6 inner denticles on *V. prendinii*).

Finally, *Vaejovis zapoteca* may be distinguished from *V. granulatus* by: (1) pectinal tooth count on males = 12–15 (mode = 13), whereas on *V. granulatus* 15–18 (mode = 17); (2) metasomal dorsolateral carinae on segment I flanked by 1 seta (2 on *V. granulatus*); (3) chela length/width 2.62 on males (3.05 on males in *V. granulatus*).

Description of holotype male.—*Coloration:* Body base color orange brown with moderately strong dusky pattern, pedipalp chela light orange with the fingers brown.

Prosoma: Anterior margin of carapace weakly concave; entire surface shagreened, sparsely granulose.

Mesosoma: Tergites shagreened. Tergites I–VI: median carina on I–II obsolete, on III–VI weak, granulose; submedian carina on I vestigial, on II weak, granular present only on the post tergite, on III–VI moderate, granular present only on the post tergite. Tergite VII: median carina present on anterior two-thirds, submedian and lateral carinae strong, granular, present only on posterior half. Genital papillae developed. Pectinal tooth count 14–14. Sternites III–VI smooth to shagreened medially, sparsely setose. Sternite VII with submedian carinae weak, smooth; lateral carinae weak, granular. Sternite VII with 10 setae.

Metasoma: Dorsolateral carinae on I–II strong, granular to crenulate; on III–IV strong, crenulate. Lateral supramedian carinae on I–IV strong, crenulate. Lateral inframedian carinae on I strong, granular; on II present only on posterior one-third, moderate, granular to crenulate; on III present only on posterior one fifth, weak, granular; IV absent. Ventrolateral carinae on I–IV strong, irregularly crenulate. Ventral submedian carina on I moderate, smooth to crenulate; on II–IV strong, smooth to crenulate. Intercarinal spaces shagreened. Segment V: Dorsolateral carinae moderate, smooth to crenulate; lateral carinae moderate, present on anterior two-thirds, crenulate; ventrolateral carinae strong, crenulate to granular; ventromedian carina strong, granular; intercarinal spaces shagreened.

Telson: Vesicle 1.53 times wider than posterior margin of segment V (Fig. 29).

Pedipalps: Orthobothrioticax "C". Femur (Fig. 23). Dorsal face with sparse, coarse granulation, shagreened. Prodorsal carina strong, granular. Retrodorsal carina moderate to weak, granular to crenulate. Proventral carina moderate, granular. Retroventral carina weak to faint, smooth. Setation (right/

left): prodorsal carinae with 1/1 dorsal seta, 2/2 medial setae on prolateral face; retroventral carinae with 1/2 setae. Patella (Figs. 24, 25) with retrodorsal carina weak, smooth; prodorsal carina moderate, granular; ventroexternal carina obsolete to vestigial, smooth; ventrointernal carina weak, granular. Setation (right/left): 3/3 setae on prolateral face. Chela (Figs. 26, 27) rounded, scalloping strong on the fingers. Digital, prodorsal and dorsal secondary carinae weak to vestigial, smooth; two prolateral carinae (dorsal and ventral) weak, granulose; all other carinae obsolete. Fixed finger (Fig. 28) with primary row divided into six subrows by five enlarged primary row denticles; six inner accessory denticles; movable finger with primary row divided into six subrows by five enlarged primary row denticles, eight inner denticles.

Legs: Basitarsus I–II with two ventrosulmedian rows of spinules, divided by three large setae. Basitarsus III with one ventrosulmedian row of spinules divided by three large setae. Basitarsus IV consist of two rows of four large setae. Telotarsus III with ventromedian row of spinules bifurcating distally, with two pairs of spinules on each leg.

Hemispermatorphore: (Figs. 50, 51). Lamelliform; hooks short, bifurcate, basal; lamella curved and wide; no sclerotized hemi-mating plug.

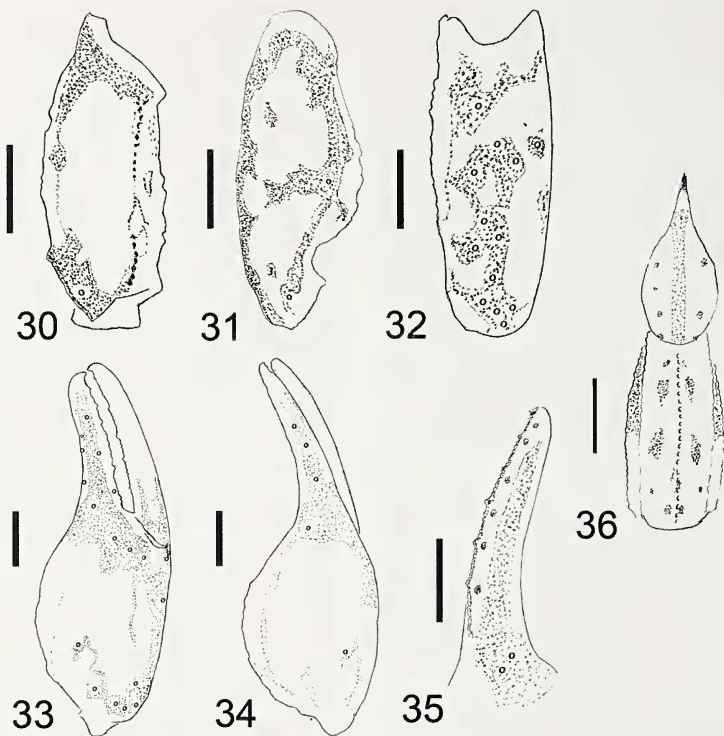
Measurements.—*Holotype male:* Total L, 31.1; carapace L, 3.8; mesosoma L, 11.5; metasoma L, 13.3. Metasomal segments: I L/W, 1.7/2.2; II L/W, 2.1/2.2; III L/W, 2.4/2.1; IV L/W, 3.1/2.1; V L/W/D, 4.0/2.0/2.0. Telson: Vesicle L/W/D, 2.5/2.3/1.4. Pedipalp: Total L, 13.1; femur L, 3.2; patella L/W, 3.6/1.1; chela L/W/D, 6.3/2.4/2.3; fixed finger L, 2.6; movable finger L, 3.6.

Paratype female: Total L, 27.1; carapace L, 3.6; mesosoma L, 9.8; metasoma L, 11.4. Metasomal segments: I L/W, 1.5/2.2; II L/W, 1.9/2.0; III L/W, 2.0/1.9; IV L/W, 2.5/1.8; V L/W/D, 3.5/1.8/1.7. Telson: Vesicle L/W/D, 2.3/1.7/1.1. Pedipalp: Total L, 11.4; femur L, 2.8; patella L/W, 3.2/1.0; chela L/W/D, 5.4/1.5/1.3; fixed finger L, 3.0; movable finger L, 3.4.

Variation.—*Vaejovis zapoteca* shows marked sexual dimorphism. Males with proportionately stouter pedipalps and longer metasomal segments, scalloping pronounced in the fingers of the pedipalp chela. Pectinal tooth count variation in Table 1. Sternite VII setae count ($n = 39$) 10 to 11 (mode = 10) Pedipalp finger dentition ($n = 24$): for the fixed finger, 24 fingers had 6 subrows of denticles; 24 fingers had 6 inner accessory denticles. For the movable finger, 24 fingers had 6 subrows of denticles. For the inner accessory denticles count we observed considerable variation between both chelae of a single specimen, so we counted both sides ($n = 48$): 1 \times 6, 6 \times 7, 31 \times 8 (= mode), 9 \times 9 and 1 \times 10 inner accessory denticles. Telotarsus III distal spinule count ($n = 39$; one telotarsus broken): 4 with 3 (1 + 2), 29 with 4 (2 + 2), and 6 with 5 (2 + 3) spinules.

Morphometric ranges: Males ($n = 11$): Chela L/W, 2.77–3.28; patella L/W, 3.00–3.40; fixed finger L/chela L, 0.37–0.44; segment V L/W, 2.10–2.35; vesicle W/posterior margin of segment V, 1.46–1.67. Females ($n = 10$): Chela L/W, 3.60–4.73; patella L/W, 2.73–3.20; fixed finger L/chela L, 0.44–0.56; segment V L/W, 1.94–2.19; vesicle W/posterior margin of segment V, 1.17–1.36.

Distribution.—Known from the Northern Mountain range of Oaxaca (the Sierra Juárez) (Fig. 1).



Figures 30–36.—*Vaejovis dzahui* sp. nov. holotype male: 30. Right femur, dorsal view; 31. Right patella, dorsal view; 32. Right patella, retrolateral view; 33. Right chela, retrolateral view; 34. Right chela, dorsal view; 35. Fixed finger, ventral view; 36. Metasomal segment V, ventral view. Scale bars = 0.5 mm.

Vaejovis dzahui sp. nov.
(Figs. 30–36)

Type data.—MEXICO: *Oaxaca*: holotype male, Distrito Coixtlahuaca, km 2 road San Cristobal Suchixtlahuaca – Santiago Tejupam (17°42.240'N, 97°23.667'W, elev. 2,290 masl), 28 June 2006, O. Francke, G. Villegas, H. Montañón and A. Valdez (CNAN-T0386). Paratypes: 5 males, 2 females, collected with holotype (CNAN-T0387); 4 males, 2 females, collected with holotype (AMNH).

Etymology.—The specific epithet is a Mixtec word meaning “rain” and it is used as a noun in apposition.

Diagnosis.—Adults 18–20 mm long. Base color yellow brown, with dark blackish markings on sternites. Pectinal tooth count on males 13–15 (mode = 14), on females 12–13 (mode = 12). Sternite VII with 10–15 setae (mode = 12). Metasomal segments short and wide, vesicle width/segment V posterior width mean = 1.09 (\pm 0.06) in males. Patella length/width mean = 2.72 (\pm 0.24) in males.

Vaejovis dzahui is similar to *V. franckei*, *V. setosus* and *V. pusillus* but it can be distinguished by the following: From *V.*

franckei differs in: (1) Chela length/width on males ranges from 2.91–3.40 (2.56–3.00 on *V. franckei*); (2) Metasomal segment V length/width on males ranges from 0.35–0.44, whereas on *V. franckei* it ranges from 0.42–0.56; (3) Metasomal segment V length/depth on males ranges from 2.20–2.60, whereas on *V. franckei* it ranges from 1.75–2.00; (4) Fixed finger length/Chela length ranges from 0.42–0.56, whereas on *V. franckei* it ranges from 0.35–0.44.

From *V. setosus* differs in: (1) Patella length/width on males ranges from 2.50–2.71, whereas on *V. setosus* it ranges from 2.70–3.33; (2) Sternite VII with modal setae counts = 12, whereas on *V. setosus* it is 20; (3) *V. dzahui* is a smaller species than *V. setosus* (see Tables 1); (4) Pectinal tooth count mode on females = 12, whereas on *V. setosus* = 14.

From *V. pusillus* differs in: (1) Chela length/width on females ranges from 2.91–4.0 on *V. dzahui*, whereas on *V. pusillus* it ranges from 4.00–4.10; (2) Pectinal tooth counts on females = 12–13, whereas on *V. pusillus* = 10–11 (mode = 11); (3) dorsolateral carinae on segment I flanked by one seta, whereas in *V. pusillus* lacks setae.

Description of holotype male.—*Coloration:* Base color yellow brown; with dark fuscous markings on tergites, metasoma and appendages; ventral aspect base color light yellow to light brown; sternites and pectines heavily mottled. Chelicerae with dusky markings limited to distal margins; cheliceral dorsal surface mostly cream yellow.

Prosoma: Anterior margin of carapace straight to weakly emarginated; surface around the median eyes densely, finely granulose, interspersed with scattered coarse granules.

Mesosoma: Tergites sparsely, coarsely granulose; shagreened. Tergites I–VI: median carina on I obsolete, on II–VI weak, granulose. Submedian carinae on I–II vestigial; on III–V weak, granulose; on VI moderate, granular. Tergite VII: median carina present on anterior two-thirds; submedian and lateral carinae strong, granular. Genital papillae well developed. Sternites III–VI smooth to shagreened medially, with dusky markings; sparsely setose. Sternite VII lateral carinae weak to faint, smooth to feebly granulose; submedian carinae absent. Sternite VII with 14 setae. Pectinal tooth count 14–14.

Metasoma: Segments I–IV: intercarinal spaces densely, coarsely granulose. Dorsolateral carinae on I strong, granular to crenulate; on II–IV strong, crenulate. Lateral supramedian carinae on I–III strong, crenulate; on IV strong, crenulate to granular. Lateral inframedian carinae on I strong, granular; on II present only on posterior half, strong, granular to serrate; on III present only on distal one-third, strong, serrate; on IV absent. Ventrolateral carinae on I moderate, irregularly crenulate; on II–IV strong, irregularly crenulate. Ventral submedian carinae on I obsolete; on II weak, granular; on III moderate, granular to crenulate; on IV strong, irregularly crenulate. Segment V: Dorsolateral carinae moderate, granular to crenulate; lateral carinae weak to moderate, granular; ventrolateral carinae strong, granular to crenulate; ventromedian carina moderate to strong, granular to crenulate. Intercarinal spaces densely, coarsely granular.

Telson: Vesicle wider than the posterior margin of segment V; ventral surface irregularly granulose, with 4 pairs of setae (Fig. 36).

Pedipalps: Orthobothriotaxic "C". Femur (Fig. 30): Dorsal surface densely, finely granulose with some coarse granulation. Prodorsal carina strong, granular to crenulate. Retrodorsal carina moderate to weak, granular. Proventral carina weak, granular. Retroventral carina weak to moderate, feebly granular. Setation (right/left): prodorsal with 4/3 setae, 3/3 medial setae on prolateral face; retroventral carinae with 2/2 setae. Patella (Figs. 31, 32) with retrodorsal carina obsolete; prodorsal carina moderate, crenulate to smooth; retroventral carina obsolete to faint, smooth; proventral keel weak, granular. Setation: 4/4 prodorsal setae. Chela (Figs. 33, 34) rounded, short. Digital, prodorsal and dorsal secondary carinae weak to vestigial, smooth; all other carinae obsolete. Fixed finger (Fig. 35) with primary row divided into six subrows by five enlarged primary row denticles; six inner denticles. Movable finger with primary row divided into six subrows by five enlarged primary row denticles; seven inner denticles.

Legs: Basitarsus I with two ventrosupmedian rows of spinules. Basitarsus II with one ventrosupmedian row of spinules, divided by 3 large setae. Basitarsus III–IV with one ventrosupmedian row of spinules, divided by 4 large setae.

Telotarsus I–IV with one ventromedial row of spinules bifurcating distally, with four spinules (2 pro- and 2 retro-lateral) on one leg and five spinules (2 + 3) on the other leg.

Hemispermatothore: Lamelliform; hooks short, thick, basal; no sclerotized hemi-mating plug (Figs. 52, 53).

Measurements.—*Holotype male:* Total L, 18.2; carapace L, 2.5; mesosoma L, 5.8; metasoma L, 8.0. Metasomal segments: I L/W, 1.0/1.5; II L/W, 1.1/1.4; III L/W, 1.3/1.4; IV L/W, 1.7/1.3; V L/W/D, 2.9/1.2/1.1. Telson: Vesicle L/W/D, 1.9/1.0/0.8. Pedipalp: Total L, 7.1; femur L, 1.7; patella L/W, 2.0/0.8; chela L/W/D, 3.4/1.0/1.2; fixed finger L, 1.6; movable finger L, 2.0.

Paratype female: Total L, 19.3; carapace L, 2.5; mesosoma L, 7.9; metasoma L, 7.2. Metasomal segments: I L/W, 1.0/1.6; II L/W, 1.1/1.4; III L/W, 1.3/1.4; IV L/W, 1.5/1.2; V L/W/D, 2.3/1.2/1.2. Telson: Vesicle L/W/D, 1.7/1.1/0.7. Pedipalp: Total L, 7.5; femur L, 1.8; patella L/W, 2.1/0.8; chela L/W/D, 3.6/0.9/1.0; fixed finger L, 1.7; movable finger L, 2.1.

Variation.—*Vaejovis dzahui* shows no marked sexual dimorphism, other than genitalia and pectines. Pectinal tooth count variation in Table 1. Sternite VII setae count ($n = 14$) 10 to 15 (mode = 12). There was no variation in the pedipalp chela finger dentition, all specimens have six subrows of denticles in both fingers; on the fixed finger all specimens have six inner accessory denticles, whereas the movable finger has seven. Telotarsus III distal spinule count ($n = 12$) two telotarsi with two (1 + 1), 12 with three (1 + 2), 9 with four (2 + 2) and one with five (2 + 3) spinules.

Morphometric ranges: Males ($n = 10$): Chela L/W, 2.91–3.40; patella L/W, 2.50–2.71; fixed finger L/chela L, 0.42–0.56; segment V L/W, 1.86–2.42; vesicle W/posterior margin of segment V, 1.11–1.33. Females ($n = 4$): Chela L/W, 3.40–4.00; patella L/W, 2.63–3.14; fixed finger L/chela L, 0.42–0.47; segment V L/W, 1.92–2.20; vesicle W/posterior margin of segment V, 1.10–1.22.

Distribution.—This species is only known from the type locality (Fig. 1).

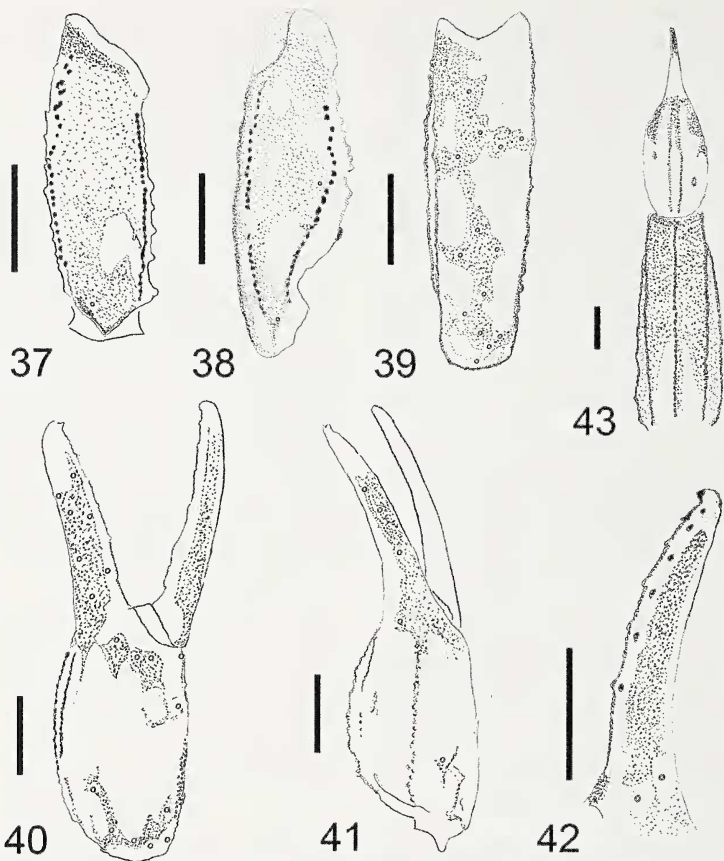
Vaejovis darwini sp. nov.
(Figs. 37–43)

Type data.—MEXICO: *Oaxaca:* Holotype male, Distrito Juquila, from 3 km west San Pedro Juchatengo (16°21.824'N, 97°06.584'W, elev. 845 masl), 27 June 2006, O. Francke, G. Villegas, H. Montañón, C. Santibáñez and A. Valdez (CNAN-T0388). Paratypes: 1 male, 1 female, collected with holotype (CNAN-T0389); 1 male, 1 female, collected with holotype (AMNH).

Etymology.—The specific epithet is dedicated to Charles Darwin in commemoration of the 200-year anniversary of his birth, and the 150th anniversary of the publication of "On the Origin of Species by Means of Natural Selection."

Diagnosis.—Adults 26–33 mm long. Pedipalp chela with dorsal marginal and prodorsal carinae moderate, granular; chela length/width mean = 3.91 (± 0.34) in males. All metasomal segments longer than wider; Segment V length/width mean = 2.58 (± 0.21) on males. Pectinal tooth count on males 17 ($n = 6$), on females 15–16 (mode = 16). Sternite VII with 11–12 setae.

Vaejovis darwini is similar to *V. nigrofemoratus*, *V. prendinii* and *V. zapoteca*; from *V. nigrofemoratus* differs in: (1) Pectinal tooth count on females = 15–16, whereas on *V. nigrofemor-*



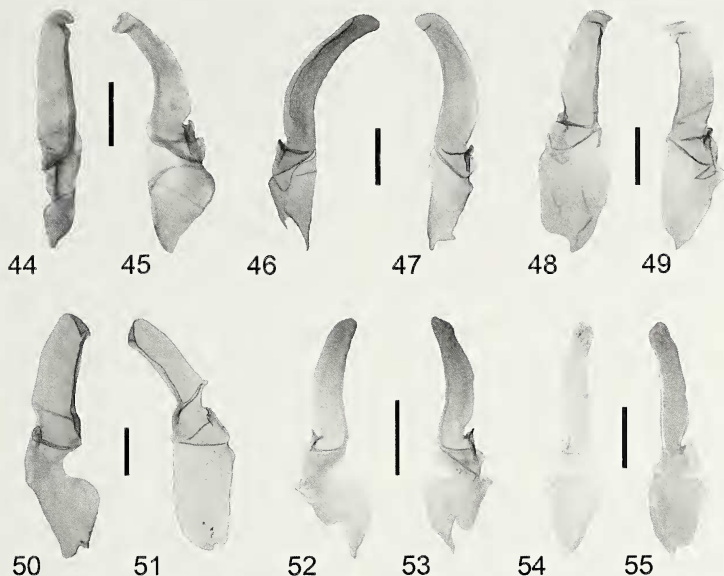
Figures 37-43.—*Vaejovis darwini* sp. nov., holotype male. 37. Right femur, dorsal view; 38. Right patella, dorsal view; 39. Right patella, retrolateral view; 40. Right chela, retrodorsal view; 41. Right chela, dorsal view; 42. Fixed finger, ventral view; 43. Metasomal segment V, ventral view. Scale bars = 1 mm.

atus = 10; (2) *V. darwini* is bigger than *V. nigrofemoratus* (Total length range = 25.0-31.1 mm against 23.60 of the holotype female, and only known specimen of *V. nigrofemoratus*); (3) Metasomal segment V length/width on females ranges from 2.25-2.58, whereas on the holotype of *V. nigrofemoratus* it is 1.88.

From *V. prendinii* it differs as follows: (1) Chela length/width on males ranges from 3.63-4.00, whereas on *V. prendinii* it ranges from 2.95-3.50; (2) Metasomal segment V length/width on males ranges from 2.53-2.81 (2.00-2.20 on *V. prendinii*); (3) Pectinal tooth count on males 17 and on females 15-16, whereas in *V. prendinii* on males = 18-20 and on females = 17-18; (4) Sternite VII setae count 11-12, mode = 12 (in *V. prendinii* = 20-23, mode = 22).

From *V. zapoteca* it can be separated by the following: (1) Vesicle width/metasomal segment V posterior margin width on males ranges from 1.00-1.17, whereas on *V. zapoteca* it ranges from 1.46-1.67; (2) Chela on adult males without scalloping in the fingers, whereas on *V. zapoteca* pronounced scalloping is present; (3) Pectinal tooth count on males = 17, whereas on *V. zapoteca* on males = 12-15 (mode = 13); (4) Femur darker on *V. darwini* than on *V. zapoteca*.

Description of holotype male.—*Coloration*: Base color yellow brown, with dark, fuscous markings on tergites, metasoma and appendages; ventrally base color light yellow to light brown; sternites heavily mottled. Chelicerae with dusky markings limited to distal margins; most of cheliceral dorsal surface cream yellow.



Figures 44–55.—Morphology of the hemispermatophores: 44. *Vaejovis setosus*, dorsal view (male from km 45.8 federal road 175, Oaxaca-Ixtlan de Juarez); 45. Same, ventral view; 46. *Vaejovis frankei*, dorsal view (male from 6 km W Llano Grande, San Antonio Cuajimoloyas); 47. Same, ventral view; 48. *Vaejovis prendini*, dorsal view (paratype male from Rio Grande, San Juan Atepec, CNAN-T0378); 49. Same, ventral view; 50. *Vaejovis zapoteca*, dorsal view (paratype male from Puerta del Sol, San Pablo Macuiltianguis, CNAN-T0382); 51. Same, ventral view; 52. *Vaejovis dzahui*, dorsal view (paratype male from km 2 road San Cristobal Suchixtlahuaca – Santiago Tejupam, CNAN-T0387); 53. Same, ventral view; 54. *Vaejovis darwini*, dorsal view (paratype male from 3 km W San Pedro Juchatengo, CNAN-T0389); 55. Same, ventral view. Scale bars = 0.5 mm.

Prosoma: Carapace anteriorly weakly emarginated; surface around median eyes densely, finely granulose interspersed with scattered coarse granules. Entire surface moderately granulose.

Mesosoma: Tergites sparsely, coarsely granulose; shagreened. Tergites I–VI: median carina on I obsolete, on II–VI weak, granulose. Submedian carinae on I–II vestigial; on III–V weak, granulose; on VI moderate, granulose. Tergite VII: median carina present on anterior two-thirds, granular; submedian and lateral carinae strong, granular. Genital papillae well developed. Sternites III–VI smooth; sparsely setose. Sternite VII with submedian carinae weak granular; lateral carinae moderate, granular. Sternite VII with 12 setae, lateral carinae, with 12 setae. Pectinal tooth count 17–17.

Metasoma: Segments I–IV: intercarinal spaces weakly, coarsely granulose, shagreened. Dorsolateral carinae on I–IV strong, crenulate. Lateral suprmedian carinae on I, strong, crenulate to granular; on II–IV strong, crenulate. Lateral inframedian carinae on I strong, granular; on II–III present only on distal one-third, moderate, granular; on IV absent. Ventrolateral carinae on I moderate, irregularly crenulate; on II strong, irregularly crenulate to smooth; on III–IV strong, crenulate to granular. Ventral submedian carinae on I weak to moderate, granular to crenulate; on II moderate, granular to crenulate; on III–IV strong, granular to crenulate. Segment V:

Dorsolateral carinae moderate, granular to crenulate; lateral carinae present on proximal two-thirds and fading distally, weak to moderate, granular to crenulate; ventrolateral carinae strong, granular to crenulate; ventromedian carina strong, granular to crenulate. Intercarinal spaces sparsely, coarsely granulose, shagreened.

Telson: Vesicle wider than posterior margin of segment V; ventral surface irregularly granulose, with 2 pairs of setae (Fig. 43).

Pedipalps: Orthobothriotic “C”. Femur (Fig. 37): Dorsal surface densely, finely granulose with some coarse granulation. Prodorsal carina strong, granular to crenulate. Retrodorsal carina moderate to weak, granular. Proventral carina moderate to weak, granular. Retroventral carina weak to moderate, feebly granular. Setation (right/left): prodorsal carinae with 4/3 setae, 2/2 medial setae on prolateral face; retroventral carina with 4/3 setae. Patella (Figs. 38, 39) with retrodorsal carina moderate to weak, granular to crenulate; prodorsal carina moderate, crenulate to smooth; retroventral carina weak, smooth to granular; proventral carina weak, granular. Setation (right/left): 6/6 prodorsal setae. Chela slender (Figs. 40, 41); dentate margins of fingers straight. Digital carinae moderate, granulose; prodorsal, dorsosecondary and retrolateral carinae moderate to weak, smooth; two prolateral carinae (dorsal and ventral) weak to moderate,

granulose; all other carinae obsolete. Fixed finger with primary row divided into six subrows by five enlarged primary row denticles; six inner denticles (Fig. 42). Movable finger with primary row divided into six subrows by five enlarged primary row denticles; seven inner denticles.

Legs: Basitarsus I with two ventrosulmedian rows of spinules. Basitarsus II with one ventrosulmedian row of spinules divided by 3 large setae. Basitarsus III–IV with one ventrosulmedian row of spinules divided by 4 large setae. Telotarsus I–IV with one ventromedial row of spinules bifurcating distally, with three spinules (1 pro- and 2 retro-lateral) on one leg and four spinules (2 + 2) on the other leg.

Hemispermaphore: Lamelliform; hooks short, basal; lamella thick and straight; not sclerotized hemi-mating plug (Figs. 54, 55).

Measurements.—*Holotype male:* Total L, 27.1; carapace L, 3.8; mesosoma L, 7.6; metasoma L, 13.1. Metasomal segments: I L/W, 1.7/2.0; II L/W, 1.9/1.9; III L/W, 2.1/1.7; IV L/W, 2.9/1.6; V L/W/D, 4.5/1.6/1.6. Telson: Vesicle L/W/D, 2.6/1.4/1.2. Pedipalp: Total L, 12.4; femur L, 3.0; patella L/W, 3.6/1.1; chela L/W/D, 5.8/1.6/1.7; fixed finger L, 2.5; movable finger L, 3.4.

Paratype female: Total L, 12.9; carapace L, 3.9; mesosoma L, 11.5; metasoma L, 13.3. Metasomal segments: I L/W, 1.7/2.4; II L/W, 2/2.2.0; III L/W, 2.2/2.0; IV L/W, 2.9/2.0; V L/W/D, 4.5/2.0/1.8. Telson: Vesicle L/W/D, 2.4/1.6/1.2. Pedipalp: Total L, 12.9; femur L, 3.0; patella L/W, 3.8/1.2; chela L/W/D, 6.1/1.6/1.8; fixed finger L, 2.8; movable finger L, 3.4.

Variation.—*Vaejovis darwini* shows no marked sexual dimorphism other than genitalia and pectines. Pectinal tooth count variation in Table 1. Sternite VII setae count ($n = 5$) 11–12 (mode = 12). There was no variation in the pedipalp chela finger dentition, all specimens have six subrows of denticles on both fingers; on the fixed finger all specimens have six inner accessory denticles, whereas on the movable finger they have seven. Telotarsus III spinule count ($n = 5$) six with three spinules (1 + 2) and four with four spinules (2 + 2).

Morphometric ranges: Males ($n = 3$): Chela L/W, 3.63–4.00; patella L/W, 3.27–3.82; fixed finger L/chela L, 0.43–0.46; segment V L/W, 2.53–2.81; vesicle W/posterior margin of segment V, 1.00–1.17. Females ($n = 2$): Chela L/W, 3.81–4.47; patella L/W, 2.85–3.27; fixed finger L/chela L, 0.40–0.43; segment V L/W, 2.25–2.58; vesicle W/posterior margin of segment V, 1.07.

Distribution.—This species is only known from the type locality (Fig. 1).

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LITERATURE CITED

- Acosta, L.E., D.M. Candido, E.H. Buckup & A.D. Brescovit. 2008. Description of *Zabius gaucha* (Scorpiones, Buthidae), a new species from southern Brazil, with an update about the generic diagnosis. *Journal of Arachnology* 36:491–501.
- Álvarez-Padilla, F. & G. Hormiga. 2008. A protocol for digesting internal soft tissues and mounting spiders for scanning electron microscopy. *Journal of Arachnology* 35:538–542.
- Francke, O.F. 1977. Scorpions of the genus *Diplocentrus* from Oaxaca, Mexico. *Journal of Arachnology* 4:145–200.
- Graham, M. 2007. Sky Island *Vaejovis*: two new species and a redescription of *V. vorhesii* Stahnke (Scorpiones: Vaejovidae). *Euscorpium* 51:1–16.
- Hendrixson, B. & W.D. Sissom. 2001. Descriptions of two new species of *Vaejovis* C.L. Koch, 1836 from Mexico, with a redescription of *Vaejovis pusillus* Pocock, 1898 (Scorpiones: Vaejovidae). Pp. 215–223. In *Scorpions 2001* In Memoriam Gary A. Polis. (V. Fet & P.A. Selden, eds.). British Arachnological Society, Burnham Beeches, Buckinghamshire, UK.
- Hoffmann, C.C. 1931. Monografías para la entomología médica de México. Monografía Num. 2. Los escorpiones de México. Primera parte: Diplocentridae, Chactidae, Vaejovidae. *Anales del Instituto de Biología Universidad Nacional Autónoma de México* 2(4):291–408.
- Koch, C.L. 1836. Die Arachniden. Getreu nach der Natur Abgebildet und Beschrieben. Volume 3. C.H. Zeh'schen Buchhandlung, Nürnberg.
- Kovařík, F. 1998. Štíři. (Scorpions). Vydalo Nakladatelství Madagascar, Jihlava. (in Czech).
- Lourenço, W. & W.D. Sissom. 2000. Scorpiones. Pp. 115–135. In *Biodiversidad, taxonomía y biogeografía de artrópodos de México: Hacia una síntesis de su conocimiento*. (J. Llorente, E. González & N. Papavero, eds.). Universidad Nacional Autónoma de México, México D.F.
- McWest, K. 2009. Tarsal spinules and setae of vaejovid scorpions (Scorpiones: Vaejovidae). *Zootaxa* 2001:1–126.
- Mondragon, D. & G.I. Cruz-Ruiz. 2009. Presence of *Vaejovis franckei* in epiphytic bromeliads in three temperate forest types. *Journal of Arachnology* 37:371–372.
- Prendini, L. & W. Wheeler. 2005. Scorpion higher phylogeny and classification, taxonomic anarchy, and standards for peer review in online publishing. *Cladistics* 21:446–494.
- Santibáñez-López, C.E., O.F. Francke & M.A. Vázquez-Dávila. 2007. La escorpiflora (Arachnida: Scorpiones) del estado de Oaxaca, una contribución a su conocimiento. *Memorias electrónicas del II Simposio sobre la Biodiversidad de Oaxaca*. CHDIR-Oaxaca.
- Sissom, W.D. 1989. Systematic studies on *Vaejovis granulatus* Pocock and *Vaejovis pusillus* Pocock with descriptions of six new related species (Scorpiones, Vaejovidae). *Revue Arachnologique* 8:131–157.
- Sissom, W.D. 1991. Systematic studies on the *nitidulus* group of the genus *Vaejovis*, with descriptions of seven new species (Scorpiones, Vaejovidae). *Journal of Arachnology* 19:4–28.
- Sissom, W.D. 2000. Family Vaejovidae Thorell 1876. Pp. 503–553. In *Catalog of the Scorpions of the World (1758–1998)*. (V. Fet, W.D. Sissom, G. Lowe & M. Braunwalder, eds.). New York Entomological Society, New York.

- Soleglad, M.E. 1973. Scorpions of the Mexicanus group of the genus *Vaejovis* (Scorpionida, Vejovidae). *Wasmann Journal of Biology* 31:351–372.
- Soleglad, M.E. & V. Fet. 2008. Contributions to scorpion systematics. III. Subfamilies Smeringurinae and Syntropinae (Scorpiones: Vaejovidae). *Euscorpius* 71:1–115.
- Stahnke, H.L. 1970. Scorpion nomenclature and mensuration. *Entomological News* 81:297–316.
- Vachon, M. 1952. Étude sur les Scorpions. Institut Pasteur d'Algérie, Alger.
- Vachon, M. 1974. Étude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). I. La trichobothriotaxie en Arachnologie, Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum National d'Histoire Naturelle, Paris*, (3), 140 (Zool. 104), mai-juin 1973:857–958 (Date on the cover 1973, published January 31, 1974; see footnote on p. 958).
- Zárate-Gálvez, K. & O.F. Francke. 2009. Nueva especie de *Vaejovis* (Scorpiones: Vaejovidae) de Chiapas, México. *Revista Ibérica de Aracnología* 17:21–28.

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